Nature Conservation

Nature Conservation 60: 139–149 (2025)
DOI: 10.3897/natureconservation.60.168638

Short Communication

First record of the white trevally (*Pseudocaranx dentex*) in the Black Sea: a new occurrence from Bulgarian coastal waters

Radoslava Bekova[1], Bogdan Prodanov[2]

1 *Department of Marine Biology and Ecology, Institute of Oceanology – Bulgarian Academy of Sciences, Varna, Bulgaria*
2 *Coastal Zone Dynamics Department, Institute of Oceanology – Bulgarian Academy of Sciences, Varna, Bulgaria*
Corresponding author: Radoslava Bekova (radoslavabekova@gmail.com)

Abstract

This study documents the first confirmed record of the white trevally (*Pseudocaranx dentex*) in the Black Sea. A specimen (354 mm TL and weight 703 g) was recorded near Varna, Bulgaria, on 24 July 2025. This observation represents the northernmost occurrence of the species along the western Black Sea coast, extending its known distribution beyond the transitional zone of the Bosphorus. The present record from Varna Bay is located approximately 330 km north of the previous northernmost confirmed occurrence in the Bosphorus Strait, marking a substantial northward extension along the western Black Sea coastline. Identification was based on morphological and meristic characteristics. Despite abundant benthic prey in the area, the specimen's empty stomach may indicate a recent arrival or a trophic mismatch. The finding supports the hypothesis of meridionalization and climate-driven range shifts of thermophilic fishes. Sea surface temperatures in the region have increased by ~0.5 °C per decade since the 1990s, creating favorable conditions for warm-water species. As a fast-growing, generalist predator, *P. dentex* may alter food web dynamics and interact with native species. This record underscores the need for sustained ichthyofaunal monitoring and further research on the ecological implications of thermophilic newcomers in the Black Sea.

Key words: Climate-driven dispersal, marine biodiversity monitoring, meridionalization, range expansion, thermophilic species, western Black Sea

OPEN ACCESS

This article is part of:
Black Sea ecosystem in the spotlight
Edited by Kremena Stefanova, Snejana Moncheva, Ertuğ Düzgüneş, Lyubomir Dimitrov

Academic editor: Kremena Stefanova
Received: 13 August 2025
Accepted: 26 October 2025
Published: 21 November 2025

ZooBank: https://zoobank.org/35FF61AF-5F37-487C-82F2-F8A9224AF6C6

Citation: Bekova R, Prodanov B (2025) First record of the white trevally (*Pseudocaranx dentex*) in the Black Sea: a new occurrence from Bulgarian coastal waters. Nature Conservation 60: 139–149. https://doi.org/10.3897/natureconservation.60.168638

Copyright: ©
Radoslava Bekova & Bogdan Prodanov.
This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0).

Introduction

The white trevally, *Pseudocaranx dentex* (Bloch & Schneider, 1801), is a thermophilic carangid fish that inhabits marine and brackish waters in tropical and subtropical regions across all major ocean basins. However, it is also occasionally found in temperate zones (Froese and Pauly 2023). The species is reef-associated and typically occurs at depths of 10–25 m, although it has been recorded down to 238 m.

The species exhibits a broad Indo-Pacific distribution, including the coasts of South Africa, Japan, Australia, New Zealand, Hawaii, Lord Howe and Norfolk Islands, and New Caledonia. It is also present in the western Atlantic from North Carolina and Bermuda to southern Brazil and in the

eastern Atlantic and adjacent seas, ranging from the Mediterranean and the Azores to Madeira, the Canary Islands, Cape Verde, Ascension Island, and St. Helena (Froese and Pauly 2023).

P. dentex is characterized by a fusiform, laterally compressed body, metallic greenish-blue dorsally and silvery white ventrally, with a prominent dark blotch on the operculum and a yellow stripe along the midline. Meristic features include 9 dorsal spines, 25–26 dorsal soft rays, 3 anal spines, 21–22 anal soft rays, and 25 vertebrae (Smith-Vaniz 1986; Kailola et al. 1993). The lateral line bears 57–78 scales on its curved section and 34–46 scutes posteriorly (Neira et al. 1998). Adults typically inhabit coastal waters, bays, and estuaries, forming schools near the bottom or around reefs and rough substrates, whereas juveniles are more common in shallower estuarine and shelf habitats (May and Maxwell 1986; Kailola et al. 1993). Feeding strategies include ram-filtering and suction feeding on plankton and benthic invertebrates (Annala 1994; Sazima 1998). Reproduction involves pelagic eggs (Smith-Vaniz 1986).

The presence of *P. dentex* has been well documented in the Mediterranean Sea. In the western basin, it was reported along the eastern and southern Adriatic coasts by Pallaoro and Jardas (1996) and Dulčić et al. (2003), and along the Italian coast by Costa (1991). More recently, Tiralongo et al. (2018) recorded the species on the southeastern coast of Sicily between 2013 and 2017. Azzurro et al. (2013) noted its regular presence in fish assemblages around Lampedusa Island in the Strait of Sicily.

In the eastern Mediterranean, the species has been reported in Syrian waters (Saad 2005), in the Levantine Sea (Gücü and Bingel 1994), and off the coast of North Cyprus during 2015–2016 (Yalgın and Türker 2023). It has also been observed along the Libyan coastline in the southern Mediterranean (Elbaraasi et al. 2019).

In the Aegean Sea, Giakoumi and Kokkoris (2013) documented the species in the coastal waters of the Cyclades Archipelago during 2007–2008. More extensive monitoring by Tüney-Kızılkaya et al. (2020) confirmed the presence of *P. dentex* around fish aggregation devices (FADs) in Kuşadası Bay, aquaculture cage areas in Güllük Bay, and reef habitats in Gökova Bay between 2009 and 2019.

This observation constitutes the first confirmed record of *P. dentex* in Bulgarian Black Sea waters and represents a significant northward extension of the species' known distribution into the Black Sea proper. Earlier investigations on ichthyofauna and fish trap catches from the Bosphorus region already indicated the presence of thermophilic Mediterranean elements in the transitional waters between the Marmara and the Black Sea (Aydınyazıcı and Öker 1960). The previous northernmost record was reported from the Beykoz coast in the Bosphorus Strait (Keskin 2023), in the transitional zone of the Mediterranean–Black Sea interface.

The aim of this report is to document and describe the first confirmed occurrence of *P. dentex* in the fully marine coastal waters of the Black Sea, based on a specimen captured near Varna, Bulgaria. Morphological and meristic traits are analyzed to confirm the species identification, and potential climatic and ecological drivers of this occurrence are discussed in the context of recent warming trends and range expansions of thermophilic fishes in the region.

Materials and methods

On 24 July 2025, a recreational diver used a speargun to capture a specimen of *P. dentex* in shallow coastal waters (depth ~4.5 m) near Trakata, Varna, Bulgaria (43°13.04061'N, 27°58.63438'E) (Fig. 1A–B). The fish was photographed *in situ* and preserved on ice before being measured and weighed. Sixteen morphometric characteristics were measured following Smith-Vaniz (1986) and are listed in Table 1 and illustrated in Fig. 3: (1) total length, (2) body depth, (3) head length, (4) snout length, (5) orbit diameter, (6) upper jaw length, (7) lower jaw length, (8) distance from snout tip to first dorsal fin

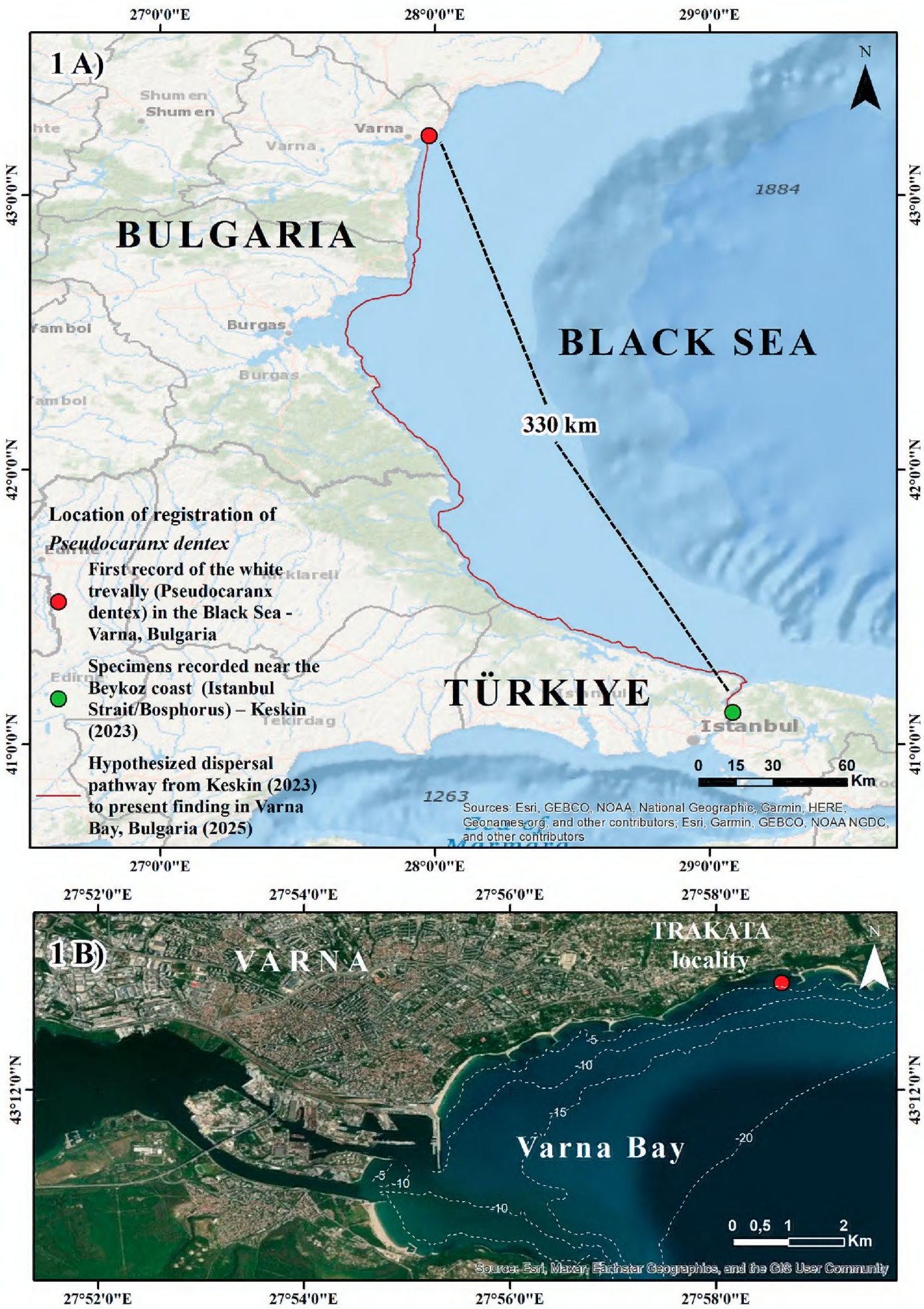

Figure 1. A. Location of the first confirmed record of *Pseudocaranx dentex* in the Black Sea; **B.** Location of the record in the Bulgarian Black Sea coastal waters at the Trakata locality, Varna Bay (red point).

Table 1. List of morphometric characteristics measured from the specimen of Pseudocaranx dentex from Varna Bay, Bulgaria, on 24 July 2025.

№	Morphometric characteristic	Abbrev.	Definition (from...to...)	Length (cm)	% TL*	% HL*
1	Total length	TL	Snout tip to caudal fin tip	35.4	100.0	343.7
2	Body depth at the first dorsal fin origin	BD	Maximum body depth at D1 origin	10.7	30.2	103.9
3	Head length	HL	Snout tip to posterior margin of operculum	10.3	29.1	100.0
4	Snout to second dorsal fin origin	S–D2	Snout tip to D2 origin	16.6	46.9	161.2
5	Diameter of orbit	ED	Horizontal eye diameter	1.8	5.1	17.5
6	Upper jaw length	UJL	Anterior tip of premaxilla to posterior end of maxilla	3.4	9.6	33.0
7	Lower jaw length	LJL	Anterior tip of dentary to posterior end of mandible	7.7	21.8	74.8
8	Snout to first dorsal fin origin	S–D1	Snout tip to D1 origin	11.8	33.3	114.6
9	Snout length	SnL	Snout tip to anterior margin of orbit	3.9	11.0	37.9
10	Snout to pectoral fin insertion	S–P	Snout tip to pectoral fin insertion	10.2	28.8	99.0
11	Snout to pelvic fin insertion	S–V	Snout tip to pelvic fin insertion	10.6	29.9	102.9
12	Snout to anal fin origin	S–A	Snout tip to anal fin origin	19.1	54.0	185.4
13	Pelvic fin length	VFL	Pelvic fin base to tip	5.4	15.3	52.4
14	Pectoral fin length	PFL	Pectoral fin base to tip	11.0	31.1	106.8
15	Interorbital length	IO	Shortest distance between the orbits (dorsal view)	9.7	27.4	94.2
16	Standard length	SL	Snout tip to caudal peduncle (end of hypural plate)	28.5	80.5	276.7

*TL – total length; HL – head length. Percentages are calculated relative to TL or HL, depending on anatomical context.

origin, (9) to second dorsal fin origin, (10) to pectoral fin insertion, (11) to pelvic fin insertion, (12) to anal fin origin, (13) pelvic fin length, (14) pectoral fin length, (15) interorbital length, and (16) standard length. All measurements were taken with a digital caliper to the nearest 0.1 mm and expressed in centimeters. No meristic features were recorded.

Results

Based on body morphology and coloration, the specimen was identified as *Pseudocaranx dentex*—a deep-bodied, laterally compressed fish with a metallic bluish-green dorsal surface, silvery flanks, and a characteristic dark spot on the operculum. The specimen measured 354 mm in total length, 285 mm in standard length, and weighed 703 g. The species determination was confirmed using keys provided in regional ichthyological literature and was consistent with the description in Keskin (2023). The present record from Varna Bay at coordinates 43°13.04061'N, 27°58.63438'E, at a depth of ~4.5 m on a sandy bottom, is located ~330 km north of the previous northernmost confirmed occurrence of *P. dentex* in the Bosphorus Strait (Keskin 2023), representing a substantial northward extension along the western Black Sea coastline (Fig. 1). After removing the stomach, it was found to be empty.

Figure 2. *Pseudocaranx dentex* and species from the family Mugilidae (Mugil cephalus, Chelon auratus) from the Trakata locality, Varna Bay, Bulgarian Black Sea coastal waters.

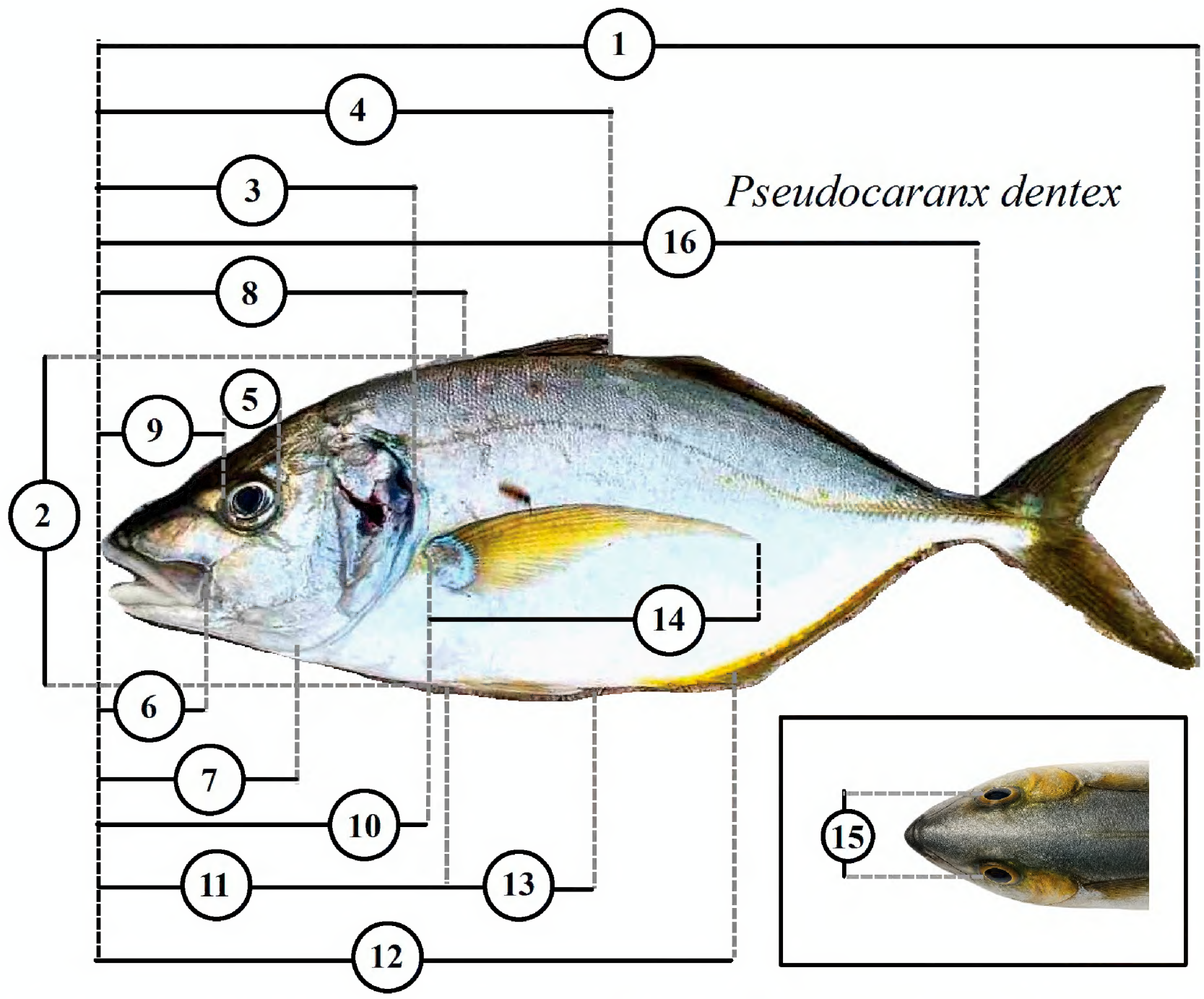

Figure 3. Diagram of morphometric characteristic measurements taken from the specimen of Pseudocaranx dentex from Varna Bay, Bulgaria, in 2025 (numbers correspond to morphometric characteristics listed in Table 1).

The diagnostic features of the examined specimen include an elongate, deep, and moderately compressed body, an elongated snout, and a weakly developed adipose eyelid. The upper jaw terminates anterior to the eye margin. The cleithrum margin is smooth and lacks papillae. Both jaws bear a single row of blunt, conical teeth, and additional teeth are present on the tongue. The spinous portion of the dorsal fin is relatively high, with the longest spine exceeding the height of the soft dorsal lobe. The pectoral fins are longer than the head, and the entire body is covered with small cycloid scales.

The body coloration is pale greenish-blue dorsally and silvery ventrally, with a prominent black spot on the posterodorsal margin of the operculum and a yellow lateral stripe that broadens posteriorly. The bases of the soft dorsal and anal fins exhibit yellow pigmentation, whereas the caudal and soft dorsal fins are dusky yellow (Fig. 2). All morphometric and meristic characteristics correspond well with the descriptions provided by Smith-Vaniz (1986). A key distinguishing trait of *P. dentex* is the notably long first dorsal spine, which exceeds the height of the second dorsal fin lobe.

In addition to the morphometric measurements, the following meristic features were recorded for the examined specimen: 9 dorsal spines, 24 dorsal soft rays, 3 anal spines, 20 anal soft rays, and 25 vertebrae. The lateral line was composed of 57 scales in the curved portion and 39 posterior scutes. These values fall within the range reported for *P. dentex* in Mediterranean and Atlantic populations (Smith-Vaniz 1986; Neira et al. 1998), further supporting the taxonomic identification of the specimen.

Discussion

The white trevally is a thermophilic marine fish belonging to the family Carangidae. It is considered medium-sized, with a typical standard length of around 400 mm (Smith-Vaniz 1986). The maximum reported size in the Mediterranean is 702 mm TL and 4,126 g (Tüney-Kızılkaya et al. 2020). However, information on the Mediterranean population of *P. dentex* remains limited, particularly regarding its distribution, feeding ecology, and reproductive biology (Dulčić et al. 2003).

According to existing knowledge, *P. dentex* typically inhabits inshore waters, with juvenile individuals forming shoals and feeding primarily on fish larvae and post-larvae (Dulčić et al. 2003), as well as euphausiid larvae, amphipods, copepods, and gastropods (Russell 1983). Adult individuals are more solitary and feed on a broad spectrum of benthic invertebrates, including squid, cuttlefish, finfish, crabs, shrimps, sea stars, sea urchins, and bivalves (Froese and Pauly 2023). Spawning generally occurs during the summer months (Smith-Vaniz 1986). Juveniles are frequently observed trailing behind species such as mullets and striped seabream in sandy-bottom habitats, often utilizing floating structures for shelter from predators. Both net and hook fisheries target the species, and in the southern Mediterranean, it is also caught using fish aggregating devices (FADs) (Deudero et al. 1999).

Marine biodiversity, including fish species such as *P. dentex*, is increasingly threatened by multiple anthropogenic pressures, including climate change, pollution, habitat degradation, overexploitation of resources, and eutrophication. Among these, global warming has emerged as a key driver of distributional shifts. Thermophilic and temperate fish species with broad

thermal tolerance (~10 °C) are exceptionally responsive to temperature changes, enabling them to maintain positive growth rates under varying thermal conditions (Pauly 2010; Cheung et al. 2013). The term "meridionalization" has been used to describe the northward range expansion of such species in both the Mediterranean and adjacent regions (Bianchi and Morri 1993). This latitudinal shift, driven by ocean warming, is recognized as one of the most observable biotic responses to climate change, particularly in marine ecosystems (Francour et al. 1994; Azzurro 2008). For instance, *P. dentex* and other thermophilic species such as *Epinephelus marginatus* and *Caranx crysos* have been documented to expand their distribution northwards in the Mediterranean Sea (Azzurro 2008).

In this context, Keskin (2023) reported the northernmost known occurrence of *P. dentex* within the Mediterranean–Black Sea transition zone, based on two individuals captured near the Beykoz coast in the Bosphorus Strait (Fig. 1A). However, due to the transitional nature of the Bosphorus, which retains characteristics more typical of the Marmara Sea in terms of oceanography and fauna, that record may not represent actual penetration into the Black Sea basin. By contrast, the present finding from Varna Bay constitutes the first confirmed occurrence of *P. dentex* in offshore waters of the western Black Sea, marking the species' first verified presence in the Black Sea proper and extending its known distribution range (Fig. 1A–B).

The examined specimen had an empty stomach, a finding of particular interest given the species' typical diet of benthic invertebrates and small demersal fishes. Along the Bulgarian Black Sea coast, potential prey organisms such as crustaceans (*Crangon crangon*, *Palaemon elegans*), mollusks (*Mytilus galloprovincialis*, *Donax trunculus*), and polychaetes (*Hediste diversicolor*) are commonly found in coastal benthic habitats. The absence of food in the stomach may indicate either recent arrival and incomplete acclimatization to local feeding grounds or a broader mismatch between preferred prey and the current state of the benthic community—a scenario potentially linked to ongoing ecological shifts in the Black Sea. This observation extends the known distribution of *P. dentex* by ~330 km northwards from the Bosphorus Strait (Keskin 2023) into the open coastal waters of the western Black Sea. Such a distance is notable for a single confirmed record and supports the view that the species is capable of substantial range shifts in response to changing environmental conditions.

Climate change and thermophilic species

Recent analyses confirm a persistent rise in sea surface temperature (SST) and increased marine heatwave (MHW) frequency in the Black Sea (Bat et al. 2024). These patterns are consistent with climate-induced range expansions observed for thermophilic species. Notably, the presence of *P. dentex* in fully marine offshore waters of the western Black Sea coincides with a well-documented long-term warming trend in the region. Satellite-based SST observations for the Black Sea show a statistically significant increase of approximately 0.65 ± 0.07 °C per decade from 1982 to 2020 (Mohamed et al. 2022), with persistent warming across seasons. This rise is accompanied by increased frequency and duration of MHWs, with observed trends of 1.4 additional events and 2.8 extra

MHW days per decade. Such changes can enhance habitat suitability for thermophilic species and promote their establishment in previously cooler regions.

These findings are supported by operational data from the Copernicus Marine Service (CMS 2024), which estimate a cumulative SST trend of approximately 0.5 °C per decade along the western Black Sea coast since the early 1990s. Together, these lines of evidence indicate that thermal conditions in the region are becoming increasingly favorable for subtropical and temperate-affinity species such as *P. dentex*.

The new record, therefore, provides further evidence that climate-driven thermal changes are actively reshaping species distributions in the Black Sea. The likely climate-related arrival of *P. dentex* aligns with the observed meridionalization processes across the Mediterranean–Pontic region.

This new record reinforces concerns that climate-induced shifts in species distributions are already affecting the ichthyofaunal composition of the Black Sea. The arrival of thermophilic species such as *P. dentex* may lead to competition with native taxa, changes in trophic interactions, and broader alterations in ecosystem functioning. The northward expansion of thermophilic species such as *P. dentex* may have cascading ecological implications, including competition with native species and alteration of food web dynamics. This highlights the importance of sustained monitoring and adaptive management strategies under changing climatic conditions.

Conclusion

This report documents the first confirmed occurrence of *P. dentex* in the coastal waters of the Black Sea, located in Varna Bay, Bulgaria, representing a notable extension of the species' known range within the northeastern Mediterranean–Black Sea system. Compared to previous records limited to the transitional zone of the Bosphorus (Keskin 2023), the finding near Varna marks the northernmost confirmed occurrence in fully marine offshore conditions of the western Black Sea. This observation aligns with a broader regional warming trend and supports the hypothesis of ongoing meridionalization and climate-driven range expansion of thermophilic marine fishes.

The specimen's morphometric and meristic characteristics were consistent with known species descriptions, confirming its identity. The empty stomach is notable given the abundance of suitable benthic prey along the Bulgarian coast. It suggests a recent arrival or a possible trophic mismatch, potentially reflecting broader ecological changes within local benthic communities.

Long-term SST analyses for the Black Sea indicate a statistically significant warming of approximately 0.6–0.65 °C per decade since the early 1980s (Mohamed et al. 2022), with additional confirmation from Copernicus Marine Service indicators estimating ~0.5 °C per decade in western coastal areas (CMS 2024). This warming is also associated with increasing frequency and duration of marine heatwaves, which affect species migration, establishment, and trophic stability. Therefore, the presence of *P. dentex* may reflect these climate-mediated habitat shifts.

Given accelerating SST trends, this record provides further evidence of climate-induced biogeographic shifts in the Black Sea. It highlights the need

for systematic ichthyofaunal monitoring to detect emerging distributional patterns, assess ecological impacts on native communities, and inform adaptive conservation and fisheries management in the face of rapidly changing marine conditions.

The entry of *P. dentex* into the Black Sea is ecologically significant because it represents the arrival of a mobile, opportunistic predator capable of exploiting diverse prey resources and occupying mid- to upper trophic levels. As a fast-growing and generalist species, *P. dentex* may influence native food webs through predation, competition, or indirect ecological interactions. Its successful establishment under warming conditions could signal broader functional changes within the Black Sea ecosystem, especially if other thermophilic species follow similar trajectories (Russell 1983; Azzurro 2008; Cheung et al. 2013; Froese and Pauly 2023).

Acknowledgements

The authors express their gratitude to Nikolay Stefanov for capturing the specimen and to Dragomir Enev for facilitating the connection.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Use of AI

No use of AI was reported.

Funding

The publication was financially supported by the project “Raising public awareness, mapping and reducing anthropogenic waste for the protection of the Bulgarian Black Sea beaches and dunes,” Grant № A24-677, part of the scientific research program of the DER TOURISTIK FOUNDATION, Germany.

Author contributions

Radoslava Bekova conceived and designed the study, conducted the literature review, identified species, performed morphological and meristic analyses, and prepared the initial manuscript draft. Bogdan Prodanov processed the GIS data, refined the figures, and carried out a critical review and revision of the manuscript. Both authors approved the final version for publication.

Author ORCIDs

Radoslava Bekova https://orcid.org/0000-0002-9353-1956
Bogdan Prodanov https://orcid.org/0000-0002-8118-3034

Data availability

All of the data that support the findings of this study are available in the main text.

References

Annala JH [comp.] (1994) Report from the Fishery Assessment Plenary, May 1994: stock assessments and yield estimates. Unpublished report held in MAF Fisheries Greta Point library, Wellington, 242 pp.

Aydınyazıcı S, Öker A (1960) Investigations on the Istanbul Strait and nearby fish traps (Part I). Et ve Balık Kurumu Umum Müdürlüğü. Balık ve Balıkçılık 8(7): 19–22. [in Turkish]

Azzurro E (2008) The advance of thermophilic fishes in the Mediterranean Sea: overview and methodological questions. Climate Warming and Related Changes in Mediterranean Marine Biota, 27–31 May, Helgoland. CIESM Workshop Monographs 35: 39–45.

Azzurro E, La Mesa G, Fanelli E (2013) The rocky-reef fish assemblages of Malta and Lampedusa islands (Strait of Sicily, Mediterranean Sea): A visual census study in a changing biogeographical sector. Journal of the Marine Biological Association of the United Kingdom 93: 2015–2026. https://doi.org/10.1017/s0025315413000799

Bat L, Kurt G, Mülayim A, Çağlar S, Öztekin A (2024) Long-term changes and causes of biota assemblages in the southern Black Sea coasts. Marine Biology Research 20(7–8): 251–265. https://doi.org/10.1080/17451000.2024.2362818

Bianchi CN, Morri C (1993) Range extension of warmwater species in the northern Mediterranean: Evidence for climatic fluctuations? Porcupine Newsletter 5(7): 156–159.

Cheung WWL, Watson R, Pauly D (2013) Signature of ocean warming in global fisheries catch. Nature 497: 365–368. https://doi.org/10.1038/nature12156

CMS (2024) Copernicus Marine Service, Black Sea Surface Temperature cumulative trend map from Observations Reprocessing. Copernicus Marine Service. https://doi.org/10.48670/moi-00218

Costa F (1991) Atlante dei pesci dei mari italiani. Ugo Mursia Editore, Milano, 438 pp.

Deudero S, Merella P, Morales-Nin B, Massutí E, Alemany F (1999) Fish communities associated with FADs. Scientia Marina 63: 199–207. https://doi.org/10.3989/scimar.1999.63n3-4199

Dulčić J, Pallaoro A, Onofri V, Lučić D, Jardas I (2003) New additional records of imperial blackfish, Schedophilus ovalis (Cuvier, 1833), white trevally, *Pseudocaranx dentex* (Bloch and Schneider, 1801), and Atlantic pomfret, Brama brama (Bonnaterre, 1788), in the eastern Adriatic. Annales. Series Historia Naturalis: Anali za Istrske in Mediteranske Študije = Annali di Studi Istriani e Mediterranei = Annals of Istrian and Mediterranean Studies 13: 149–154.

Elbaraasi H, Elabar B, Elaabidi S, Bashir A, Elsilini O, Shakman E, Azzurro E (2019) Updated checklist of bony fishes along the Libyan coasts (Southern Mediterranean Sea). Mediterranean Marine Science. https://doi.org/10.12681/mms.15570

Francour P, Boudouresque CF, Harmelin JG, Harmelin-Vivien ML, Quignard JP (1994) Are the Mediterranean waters becoming warmer? Information from biological indicators. Marine Pollution Bulletin 28: 523–526. https://doi.org/10.1016/0025-326x(94)90071-x

Froese R, Pauly D [Eds] (2023) FishBase. World Wide Web electronic publication. https://www.fishbase.org

Giakoumi S, Kokkoris GD (2013) Effects of habitat and substrate complexity on shallow sublittoral fish assemblages in the Cyclades Archipelago, North-eastern Mediterranean Sea. Mediterranean Marine Science 14. https://doi.org/10.12681/mms.v0i0.318

Gücü AC, Bingel F (1994) Trawlable species assemblages on the continental shelf of the north eastern Levant Sea (Mediterranean) with an emphasis on Lessepsian migration. Acta Adriatica 35: 83–100.

Kailola PJ, Williams MJ, Stewart PC, Reichelt RE, McNee A, Grieve C (1993) Australian fisheries resources. Bureau of Resource Sciences, Canberra, Australia, 422 pp.

Keskin Ç (2023) Northernmost occurrence of the white trevally, *Pseudocaranx dentex* (Bloch & Schneider, 1801), in the Mediterranean and Black Seas system. Journal of the Black Sea/Mediterranean Environment 29(3): 297–303.

May JL, Maxwell JGH (1986) Trawl fish from temperate waters of Australia. CSIRO Division of Fisheries Research, Tasmania, 492 pp.

Mohamed B, Ibrahim O, Nagy H (2022) Sea surface temperature variability and marine heatwaves in the Black Sea. Remote Sensing 14. https://doi.org/10.3390/rs14102383

Neira FJ, Miskiewicz AG, Trnski T (1998) Larvae of temperate Australian fishes: laboratory guide for larval fish identification. University of Western Australia Press, 474 pp.

Pallaoro A, Jardas J (1996) Ichthyological collection of the Institute of Oceanography and Fisheries in Split (Croatia). Natura Croatica 3: 177–219.

Pauly D (2010) Gasping fish and panting squids: oxygen, temperature and the growth of water breathing animals. Excellence in Ecology 22, International Ecology Institute, Oldendorf/Luhe, Germany, [xxviii +] 216 pp.

Russell BC (1983) The food and feeding habits of rocky reef fish of north-eastern New Zealand. New Zealand Journal of Marine and Freshwater Research 17: 121–145. https://doi.org/10.1080/00288330.1983.9515991

Saad A (2005) Checklist of bony fish collected from the coast of Syria. Turkish Journal of Fisheries and Aquatic Sciences 5: 99–106.

Sazima I (1998) Field evidence for suspension feeding in *Pseudocaranx dentex*, with comments on ram filtering in other jacks (Carangidae). Environmental Biology of Fishes 53: 225–229. https://doi.org/10.1023/a:1007492803796

Smith-Vaniz WF (1986) Carangidae. In: Whitehead PJP, Bauchot ML, Hureau JC, Nielsen J, Tortonese E (Eds) Fishes of the North-eastern Atlantic and the Mediterranean, Vol. II. UNESCO, Paris, 815–844. https://doi.org/10.2307/1444931

Tiralongo F, Tibullo D, Messina G, Lombardo BM (2018) New records of two carangid species from the south-east coast of Sicily (Ionian Sea) and considerations about their presence and abundance. Acta Adriatica 59: 225–230. https://doi.org/10.32582/aa.59.2.8

Tüney-Kızılkaya İ, Akyol O, Özgül A (2020) On the occurrence of *Pseudocaranx dentex* (Carangidae) in the Turkish Aegean Sea (Eastern Mediterranean Sea). Annales. Series Historia Naturalis : Anali za Istrske in Mediteranske Študije = Annali di Studi Istriani e Mediterranei = Annals of Istrian and Mediterranean Studies 30(1): 53–60.

Yalgin F, Türker A (2023) Determination of fish diversity in the northern coasts of Cyprus (Eastern Mediterranean) by visual census method. Marine Science and Technology Bulletin 12: 111–122. https://doi.org/10.33714/masteb.1232007